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Seasonal and Rotational Influences on Corn Nitrogen Requirements

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Abstract
This project was designed to study the N fertilization needs in continuous corn (CC) and corn rotated with soybean (SC) as influenced by location and climate. Multiple rates of fertilizer N were spring applied, with the intent to measure yield response to N within each rotation on a yearly basis for multiple years at multiple sites across Iowa. This will allow the determination of N requirements for each rotation, differences that exist between the two rotations, responses to applied N across different soils and climatic conditions, and evaluation of tools used to adjust N application.

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Seasonal and Rotational Influences on Corn Nitrogen Requirements

RFR-A11101

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Introduction

This project was designed to study the N fertilization needs in continuous corn (CC) and corn rotated with soybean (SC) as influenced by location and climate. Multiple rates of fertilizer N were spring applied, with the intent to measure yield response to N within each rotation on a yearly basis for multiple years at multiple sites across Iowa. This will allow the determination of N requirements for each rotation, differences that exist between the two rotations, responses to applied N across different soils and climatic conditions, and evaluation of tools used to adjust N application.

Materials and Methods

The first year of this research at the ISU Armstrong Research Farm was 2001. The study area was cropped with soybean in 2000, therefore, in the initial year all yields follow soybean. The two rotations were initiated in 2001. The soil is Marshall silty clay loam.

Tillage was fall chisel plow and spring disk before planting. Rates of N applied to corn are 0 to 240 lb N/acre in 40-lb increments. In 2011, urea-ammonium nitrate solution (32% UAN) was sidedress injected after planting. No N was applied with the planter. The farm superintendent chose the corn hybrid and soybean variety. Pest control practices were those typical for the region and rotations. Corn and soybean were harvested with a plot combine and yields corrected to standard moisture.

Results and Discussion

In 2011, corn yields were lower than previous years (Table 1), and likely a reflection of the corn hybrid and climatic conditions. The calculated economic optimum N rate (EONR) in 2011 was quite low for SC, 86 lb N/acre, and more normal for CC, 187 lb N/acre. These results are likely a response to drier than normal conditions.

The corn yield at the economic optimum N rate (EONR) was 19 bushels/acre higher in the SC rotation compared with CC. For the past ten years, corn yield has averaged 8 percent higher in the SC rotation (195 vs. 180 bushels/acre, including 2002, a year with very low yield due to dry conditions). Soybean yield in the SC rotation averaged 54 bushels/acre in 2011.

Figure 1 shows the yield response to N rate each year for the SC and CC rotations. In addition, the graphs show the yield each year at the EONR and yield if a constant Maximum Return To N (MRTN) rate were applied each year. Despite the large variation in yield between years, the yearly EONR and the MRTN rate resulted in corn yields quite close to the maximum yield. Only in 2009 for SC and 2010 for CC did the yield at the MRTN rate fall below the yearly EONR yield. These results indicate that the MRTN rate provides for optimal economic corn grain production, and like EONR, yields close to the maximum yields each year.

Acknowledgements

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Table 1. Corn grain yield as influenced by N fertilization rate in 2011, ISU Armstrong Research Farm, Lewis, IA.

N Rate	SC	CC
lb N/acre	- - - - - - - bu/acre - - - - - - -	
0	135	46
40	150	80
80	168	101
120	164	132
160	159	143
200	172	142
240	162	146

SC, corn following soybean; CC, corn following corn.

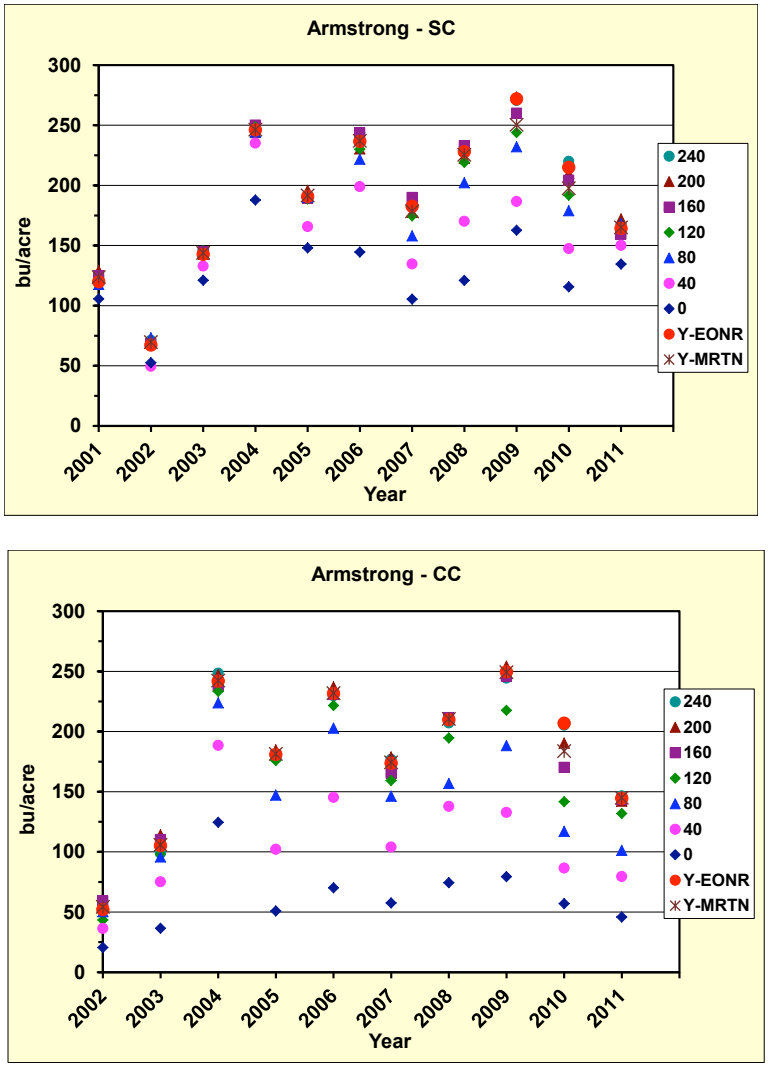

Figure 1. Nitrogen rate effect on corn yield over time for each rotation, yield at the economic optimum N rate (Y-EONR) each year, and corn yield if a constant Maximum Return To N (Y-MRTN) rate was applied each year, ISU Armstrong Research Farm, Lewis, Iowa, 2001–2011. The MRTN rate used was 133 lb N/acre for SC and 190 lb N/acre for CC (rates from the 2011 Corn N Rate Calculator web site at a 0.10 price ratio, $/lb N:$/bu corn grain).